UNITED STATES PATENT APPLICATION

HVAC SYSTEM WITH ENVIRONMENTAL CONTAMINANT PROTECTION

REFERENCE TO RELATED PROVISIONAL APPLICATION

This application claims benefit under §119(e) of the U.S. Patent Act (35 U.S.C. 119(e)) to U.S. Provisional Application No. 60/423,834 filed November 5, 2002.

FIELD OF INVENTION

This invention relates generally to HVAC units for environmental systems, specifically, to an improved system for preventing entry of contaminants through the use of improved evaporator coil compartment pressurization and also having increased operational efficiency.

BACKGROUND OF THE INVENTION

A typical air conditioner in a HVAC system includes an evaporator, compressor, condenser and return capillary tube. A refrigerant, such as Freon, is placed in the system's evaporator coil and as warm air passes over the evaporator coil, the refrigerant absorbs heat and starts to boil. The boiling refrigerant passes through the compressor which removes the fluid vapor and increases the pressure of the refrigerant gas. The hot, high pressure vapor is then pumped to the condenser coil and condenses back into liquid refrigerant by passing through the condenser coil in which ambient air absorbs heat from the hot, high pressure vapor. The liquid refrigerant then passes through an expansion valve which changes the liquid refrigerant into cold, low pressured gas that is returned to the evaporator coil to continue the system cycle. Throughout the process, the evaporation and condensation portions of the process are aided by fans that blow air over the respective coils thereby efficiently expelling the respective hot or cold air.

The HVAC system moves large amounts of air within the environment being heated, cooled, and/or ventilated, from the external environment and inside the air conditioning system itself. Accordingly, numerous opportunities exist for contaminants in one area to move to another area of the system. Specifically, for environmentally sensitive applications such as

military, medical or cleanroom operations, it is important that outside contaminants such as chemical, biological or radiological contaminants not enter into the interior environment.

The most obvious approach is to attempt to seal the units in such a manner as to prevent any contaminant entrance. However, this has substantial problems since any minor system leak or puncture or separation in the ducts may permit contaminants to enter the system.

A better existing approach is to place the evaporator coil and heater within a pressurized evaporator compartment. The air from the fan that blows through the evaporator coil and heater then serves to both blow air into the controlled environment and creates an environment within the evaporator compartment that has a positive pressure relative to the ambient environment outside the evaporator compartment. Consequently, if any leakage exists or develops, the air from the inside of the compartment would exit to the lower pressure exterior environment rather than permitting the contaminants to enter the compartment and be blown by the fan into the controlled environment. Further, to reduce the opportunities for contaminants to enter the system, the return air duct from which air is taken by the fan and moved into the evaporator compartment can be a coaxial duct in which the outside layer of the duct is pressurized and the inside layer of the duct is the suction area supplying air for the fan. The outer layer of the duct resists contaminant entry in the same manner as the evaporator compartment, namely, by having any leaks in the duct be biased toward escape toward the lower pressure exterior environment.

In the approach described above with the pressurized evaporator compartment and coaxial return duct, the system fan being used is a traditional axial fan with a fan housing. The fan directs the air across the evaporator coil, and accordingly, is typically positioned perpendicular to the evaporator coil to center the airflow over the coil. This approach results in an airflow that is concentrated in the center of the evaporator coil and reduced toward the edges of the coil. Further, traditional fans require fan housings both for safety and to assist in directing the air flow resulting in an additional operating part with additional weight and cost and potential vibration issues. Also, since the axial fan must be arranged perpendicularly to blow air across the evaporator coil, it results in a geometric arrangement of the components that requires a larger evaporator compartment. As a result, significant improvement can still be made relative to the operation of anti-contaminant environmental systems.

SUMMARY OF THE INVENTION

The object of the present invention is to utilize an improved fan assembly to increase evaporator coil efficiency and overall evaporator compartment pressurization and reduce size and weight in anti-contaminant environmental systems.

The present invention is an anti-contaminant environmental system using a pressurized evaporator compartment and coaxial air duct with a radial blower fan. As described above, the fan moves air across the evaporator coil and/or heater and maintains the evaporator compartment and outer layer of the coaxial duct at a positive pressure relative to the outside environment. The radial fan has an impeller with blades that are disposed on a rotating frame resulting in an air flow that is distributed 360 degrees around the fan. This air flow results in an even flow over the evaporator coil and heater since the air flow does not approach the coil perpendicularly as with a traditional fan; instead the air approaches the coil from a plurality of directions. Further, the more widespread airflow decreases the likelihood of a negative pressure area within the compartment since the air flow is more evenly distributed throughout the compartment and as mentioned previously, this reduces the possibility of contaminant entry into the system.

The specifications of the radial fan, including its location, size and impeller rotational rate, are dependent on the structure of the evaporator compartment and coaxial duct to be pressurized. The fan itself could be composed of nearly any material imaginable, although lightweight, strong and easily formed materials such as plastic, metal alloys or ceramic or fiber compositions would be preferable.

One advantage of the invention is that it more evenly regulates the positive pressure throughout the evaporator compartment and coaxial duct. Another advantage is that the invention increases the efficiency of the air conditioning unit by improving air flow over the entire evaporator coil. Another advantage is that the radial blower fan weighs less than a convention axial fan and does not require use of a fan housing thereby reducing the fan assembly weight and number of parts in the system and eliminating a potential source of vibration. Another advantage is that the radial blower fan does not need to be directed to blow air over the evaporator coil, thereby enabling a geometric arrangement that permits an evaporator compartment with a smaller footprint and reduced weight.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A and 1B are perspective views of the HVAC system. FIG. 1A shows the system with coaxial duct and FIG. 1B shows the system with a traditional single layer air duct.

FIG. 2 is an enlarged perspective view of the fan assembly.

FIG. 3 is a view similar to FIG. 1 but of a prior art configuration with a traditional axial fan.

DETAILED DESCRIPTION

FIGS. 1A and 1B each illustrate an anti-contamination HVAC system 10 having an evaporator compartment 12 with a supply air duct 14 and return air duct 15. FIG. 1A depicts a coaxial return air duct having an inner suction area 16 and outer pressurized area 17. The evaporator coil 20, heater 21, and blower fan assembly 22 are disposed within the evaporator compartment 12. The fan assembly consists of a fan motor 24 and fan impeller 25 which is attached to the shaft of the motor 24. The airflow into the compartment 12 is shown by the arrows at a, airflow from the fan is shown by the arrows at b, airflow out of the compartment to the supply air duct is shown at c and airflow out of the compartment into the pressurized coaxial duct is shown by the arrows at d.

FIG 2 illustrates the radial blower fan assembly 22. The assembly has a fan motor 30 and impeller 32. The impeller 32 is comprised of a frame 34 with fan blades 35 disposed between the frame members. The blades 35 can be attached by a variety of attachment means, but in the present embodiment they are welded to the frame 34. Further, the impeller 32 and blades 35 can be any number of different shapes and sizes and the blades 35 can be disposed at varying angles about the frame 34.

FIG 3 illustrates an anti-contamination HVAC system 10 using a traditional fan assembly 22 with a traditional axial fan blade 25. The airflow from the fan is shown by the arrows at b and results in a narrow column of air initially passing primarily across cross-sectional area X of the evaporator coil 20 prior to exiting the system as shown by the arrows at c.

The preceding description of the invention has shown and described certain embodiments thereof; however, it is intended by way of illustration and example only and not by way of limitation. Those skilled in the art should understand that various changes, omissions and additions may be made to the invention without departing from the spirit and scope of the invention.